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The mining resource cycle and settlement demography in Malå, Northern Sweden

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Research Article

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Abstract

Research on the demographic impacts of mining in sparsely populated areas has focused primarily on relatively large towns. Less attention has been paid to smaller villages, which may experience different impacts because of their highly concentrated economies and their small populations, making them more vulnerable to demographic "boom and bust" effects. This paper examines demographic change in four small villages in northern Sweden, which are located close to several mining projects but have evolved through different degrees of integration with or separation from mining. Using a longitudinal "resource cycle" perspective, the demographic trajectories of the villages are compared to understand how different types of settlement and engagement with mining have led to different demographic outcomes in the long term. While the four villages experienced similar trajectories in terms of overall population growth and decline, their experiences in relation to more nuanced indicators, including age and gender distributions and population mobilities, were different, and potential reasons for this are discussed. Due to data limitations, however, the long-term demographic consequences of mining for local Sami people remain unclear. The paper problematises this research gap in light of general concerns about mining impacts on traditional Sami livelihoods.

Introduction

While there is increasing attention to the demographic impacts of resource projects on nearby settlements, empirical analyses that take a "resource cycle" approach are rare (Carson, Sköld, Carson, & Nilsson, 2016). Of particular interest is how demographic impacts may differ over time according to the degree of relationship between a resource project and nearby towns and villages. In some cases, project planners aim to use and extend existing housing and other infrastructure to accommodate changes in population resulting from those projects, while in other cases, mines lead to new settlements which remain largely separate from existing towns (Storey, 2016). Many projects fall somewhere along this "integration-separation" continuum, with some new and separated development (such as a workers' camp) and some interaction with existing settlements. The purpose of this paper is to examine demographic change in four small settlements located close to a series of mining projects that were undertaken in the Malå region of northern Sweden in the mid-20th century. The paper not only contributes to a "resource cycle" understanding of demographic change but also to understandings of the human geography of small settlements or "villages" in sparsely populated resource peripheries (Carson, Carson, Porter, Ahlin, & Sköld, 2016).

The arguments for greater integration of resource projects such as mining with existing settlements are that integrated projects are more likely to lead to local population and economic growth, to generate local employment and to be subject to locally driven monitoring of environmental and other impacts (Zhang & Moffat, 2015). Arguments for greater separation include that separation can help avoid the negative social impacts of rapid population growth (and decline), crowding out of local populations (through increased cost of housing or fear of crime, e.g.), and the heavy male bias that is inherent in populations of mining dominated regions (Carrington, Hogg, & McIntosh, 2011; Storey, 2010).

The "integration-separation" challenge is greater in locations where the incoming mining workforce is large compared to existing populations. While this may be the case even in quite large cities, it is more common in more sparsely populated rural areas, which have smaller settlements that are subject to potentially large demographic impacts arising from even small changes in conditions (Carson, Carson, Nordin, & Sköld, 2016). A number of analyses of demographic change in such regions have recently emerged in the literature, focusing on the global resources boom of the early 21st century (Carrington & Pereira, 2011; Franks, Brereton, & Moran, 2013; Kotey & Rolfe, 2014). The literature would also benefit from historical analysis, which can potentially cover the mining resource cycle more completely beyond the most recent "boom and bust" phase, and can thus contribute to a better understanding of

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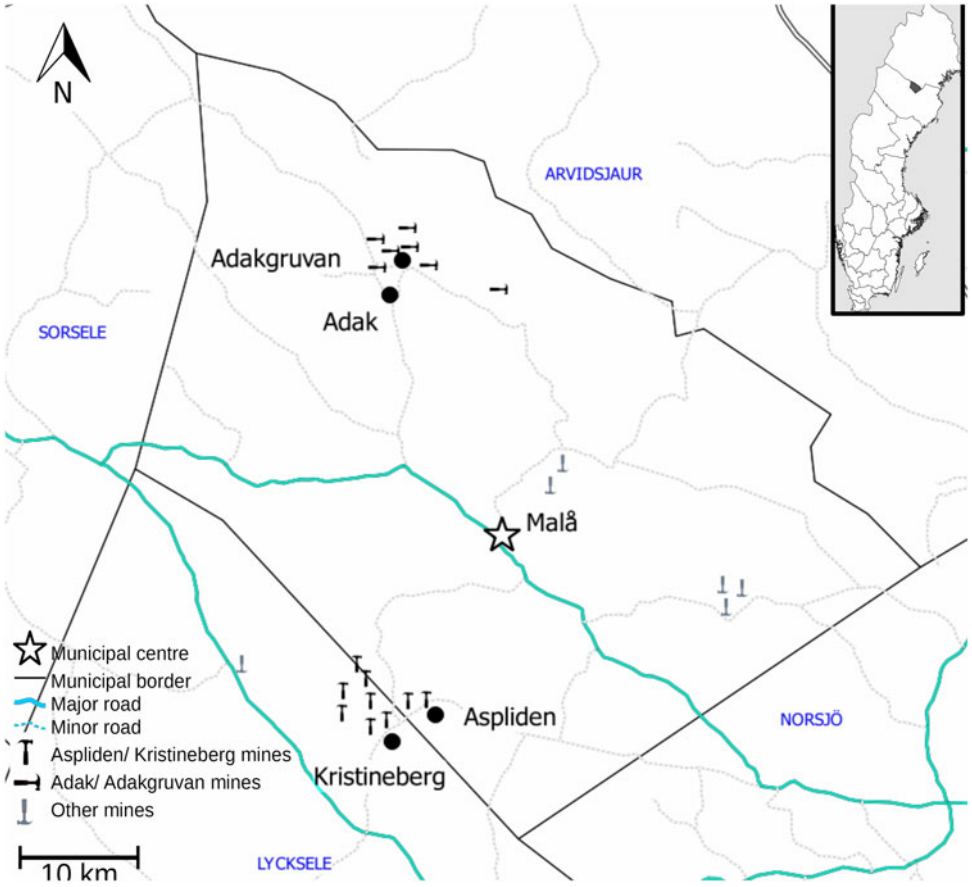

Fig. 1. The four focus villages and 20th century mining project locations in the Malå region.

how relationships between mining projects and local village communities may change over time. The aim of this paper is to examine whether different processes of demographic change occurred in villages more integrated or separated from mining projects in the Malå region during the last century and to discuss how integration-separation and other factors may have played a role in determining demographic outcomes.

The paper traces the demographic development of four villages (Fig. 1) from the start of the 20th century until 2015 when all but one mining project had ended. The villages include a pre-existing settlement that was highly integrated in providing housing and services for mine workers (Adak), a pre-existing village that was largely separated from mining (Aspliden), a company town intended for only temporary occupation (Adakgruvan) and a company town intended to be a more permanent settlement (Kristineberg). The villages are perhaps better considered as two pairs – Adak and Adakgruvan and Aspliden and Kristineberg. The paired villages are situated within a few kilometres of one another but are separated from the other pair by 40 km of road and a number of other settlements including the main administrative centre for the Malå local government area. Adak, Kristineberg and Aspliden continue to be inhabited, while Adakgruvan was dismantled and uninhabited by the end of the 1970s.

Demography and the mining resource cycle in sparsely populated areas

Carson, Sköld, *et al.* (2016) proposed a "resource cycle" framework for analysing the demographic impacts of natural resource projects in sparsely populated areas. The framework follows the one proposed by Clapp (1998) and others for examining the economic impacts of projects in forestry, fishing, mining (Keeling, 2010) and power generation (Epstein *et al.*, 2011). The "cycle" describes certain stages which may apply to natural resource projects, without requiring that projects progress in a linear way from one stage to the next (although many do). A recent application of the resource cycle model to demographic analysis of hydropower development in northern Sweden suggested impacts including rapid population growth and decline, a persisting male bias (even as the population aged) and an increasing dislocation between the human resource characteristics of the resource activity and local demographic characteristics (Carson, Carson, Nordin, *et al.*, 2016). Carson, Sköld, *et al.* (2016) and Carson, Carson, Nordin, *et al.* (2016) suggested that demographic impacts over time are affected by a "settlement cycle" which involves a progression from close integration of new populations with existing settlements, to the construction of new towns and villages to house resource project workers in the short term but to become long-term population centres, to temporary accommodations for workers and their families, to "camps" and other structures designed for workers who primarily reside elsewhere (also see Storey (2016) for a discussion of the evolution of different resource town models in sparsely populated areas). In the Malå mining case in this paper, at least the first three of these settlement forms were employed at the same time.

Carson, Sköld, *et al.* (2016) summarise the resource cycle in five broad phases. The *pre-development* phase involves exploration and initial discovery of a resource. The *early period* focuses on test

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extraction and construction of the initial extractive infrastructure. The *middle period* involves extraction of the most easily accessible resources in order to pay off exploration and construction costs and move to profitable operation. The fourth phase was termed "decline" and refers to periods where there is lower than peak production, and projects seek increased labour efficiencies to offset higher production costs. Finally, projects may experience a *transition* and closure phase, which can be more or less permanent. Constantly changing extractive technologies mean that projects can achieve labour efficiencies even at peak production and can return to peak production even following a period of decline (Alpha & Ding, 2016). Transition might not always result in (permanent) closure but may include changes of ownership or specialisation of extraction (mining tailings, focusing on certain types or quality of ores, e.g.). The negative economic impacts of closure can be tempered by "constructive planning" which involves anticipating opportunities for adjustment to new economic conditions and the possibilities for alternative economic developments (Thorpe & Sandberg, 2007).

Primarily, resource cycle demographic studies have focused on regions, or relatively large population centres, and typically compare one part of the resource cycle with one other part, rather than examining demographic trajectories over a longer period of time covering the whole cycle. The most common combinations are comparisons of (immediate) pre-development with early or middle phase, and middle phase with decline or transition. Analysis is largely restricted to gross population change or changes within the labour force, with less attention paid to issues such as gender, ageing and ethnicity.

Overall, the literature tends to emphasise negative demographic impacts of resource projects in sparsely populated areas. The main impacts are expected to be rapid population growth and decline, a male bias, and marginalisation of groups such as women and Indigenous people (Taylor & Carson, 2014). Resource development is therefore associated with "unbalanced" demographic profiles that can create social unrest and limit the diversity of interests and skills which can be used to stimulate alternative and supplementary forms of development (Black, McKinnish, & Sanders, 2005; Carson & Carson, 2014). Resource cycle "busts" leave communities with a surplus of males, rapid population ageing and a lack of young adults and families who could lead the transition to new activities (Ryser & Halseth, 2013). Populations attracted to the area by the boom quickly leave to find the next opportunity, and they are often not replaced (Halseth, 1999).

Resource projects may, however, bring demographic benefits to sparsely populated areas, stimulating in-migration and increasing demographic diversity, including sources of migrants. The infrastructure associated with resource developments likely would not otherwise have been constructed and can form the foundation for additional and post-project development (Byström, 2019). Resource projects can inject new populations into otherwise declining areas and provide opportunities for young people to find work in the region. Resource projects stimulate population mobility (through the flow of workers and others), opening regions to new sources of ideas and new connections with the outside world (Keough, 2013). Resource projects can help Indigenous communities achieve some level of economic independence and sustainability through employment and royalty payments (Langton, 2012; Carson, Govan, & Carson, 2018).

Whether a mining project results in long-term positive or negative demographic change, or what mix of positive and negative demographic impacts arise from a mining project, may be determined by a range of factors. Not the least of these is the extent to which the project represents a new form of development (Ryser, Markey, Manson, & Halseth, 2014). Some sparsely populated areas are well-established resource peripheries with long-term engagement in a range of resource extractive activities which have demographic demands that are very similar to those of mining. Other regions and localities might experience mining as a substantial change from previous activities such as family-based farming and animal husbandry, tourism or services, triggering a shift in labour demands and demographic structures (Leonard, 2016; Measham & Fleming, 2014). Individual towns and villages have certain assets which enable them to absorb new populations and manage demographic change more or less effectively. These assets can include physical infrastructure, proximity to other settlements, and the level of community engagement in planning and development processes. The extent to which these processes constitute "constructive planning" is also important (Lane, 2006), with persistence of pre-existing non-mining activities and adoption of new activities early in the resource cycle likely to produce more positive long-term demographic outcomes (Aarsæther, Riabova, & Bærenholdt, 2004). Finally, environmental and infrastructure legacies can impact demographic development. The loss of environmental assets might jeopardise traditional Indigenous livelihoods (Carson *et al.*, 2018). It might also change the attractiveness of the place for new populations, as might the treatment of mining and associated transport infrastructure as eyesore, tourist attraction or ongoing community asset (Carson & Carson, 2014; Metsaots, Printsmann, & Sepp, 2015). There is potential for great diversity in these attributes even among towns and villages that are relatively proximate to one another.

This paper examines the extent to which the mining "boom" in Malå in the mid-20th century was associated with demographic change in four villages. Situating the research around four different villages allows for examination of the impact that different levels of integration with and separation from mining activity might have had on long-term demographic development, as well as some exploration of how even small differences in environmental, social and infrastructure conditions as described in the previous paragraph might have contributed to different demographic outcomes throughout the entire mining resource cycle. Of particular interest are rates and timing of population growth and decline, sources of new populations, issues of demographic "balance" in gender and age profiles, and the Indigenous geography of these settlements, although this latter is problematic given the lack of statistical information on Sami populations in Sweden since the early 20th century (as discussed below).

The research setting

During the 20th century, there were 28 mining projects undertaken in which either Adak or Aspliden were the nearest pre-existing settlement (see Fig. 2). Mining focused on copper, zinc and other sulphides. The first operating mine was opened near Adak in 1932, and the last was opened at Kristineberg in 1976 and continues to this day. Mining activity peaked during the 1960s and 1970s, with at one stage 13 active projects. Almost all projects were operated by the locally owned mining company Boliden, which is headquartered near the city of Skellefteå (some 100 km to the east) and has become gradually globalised (and stock listed) since the mid-1990s. The Kristineberg mine is still operated by Boliden today. Figure 2 shows the population development of Malå municipality from 1900 until 2015. The population increased quite rapidly in the

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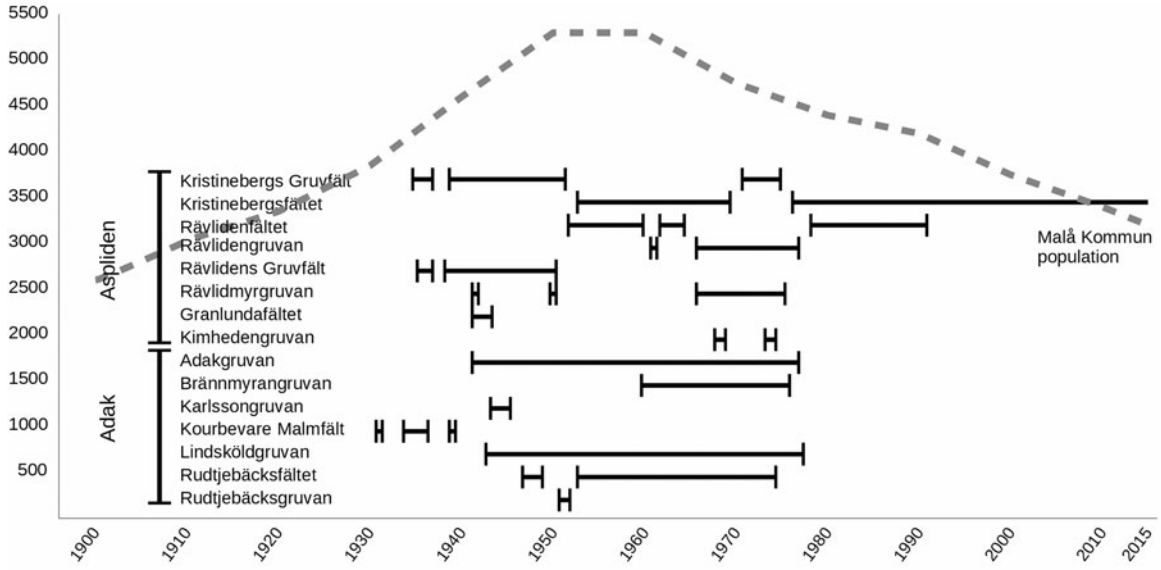

Fig. 2. Timeline of mining activity near Adak and Aspliden, including Malå municipal population development, 1900–2015.

first half of the 20th century to a peak of about 5300 people between 1950 and 1960. By 1970, the municipal population was already declining, and there has been a steady decline since.

The period from 1900 to 1930 might be considered the pre-development phase of this resource cycle, while the early phase includes preparation and construction occurring during the 1930s, and early operations in the 1940s. The middle phase spans the 1950s and 1960s, with decline beginning in the 1970s. Transition began in the 1980s.

Prior to the mining boom, Kristineberg was essentially a single-family satellite homestead for the nearby farming settlement of Aspliden, which had a population of about 80 people in 1930 (Lundmark, 1943). Virtually all employed persons in Aspliden in 1930 were tenant farmers, small landholders or domestic workers, and the village had very limited commercial services and social infrastructure at that time. The 1930 census identifies one nurse, but no shopkeepers, teachers or other service or trades workers. Kristineberg was purpose built at the end of the 1930s to service the nearby mines and had a population of about 400 people by 1940 which increased to around 1000 at its peak in the 1960s. The settlement was built to include a range of commercial and public services including schools, shops, sports facilities and a health centre. It was intended to be self-sufficient in this regard, and to be attractive to mine workers and their families, along with entrepreneurs looking to service these populations. Aspliden also benefitted from the nearby mining boom, although it remained much smaller, peaking at about 200 people in the early 1960s.

Both, Kristineberg and Aspliden entered a period of population loss between 1960 and 2000, accompanied by a loss of social, public and commercial services. Aspliden's population has somewhat stabilised since the year 2000 (at around 50 residents), but there is ongoing population loss in Kristineberg, which has declined to fewer than 200 residents today. This decline has occurred despite continuing mining operations in very close proximity to Kristineberg. The mining company no longer maintains facilities or houses workers in Kristineberg, a process of withdrawal that commenced in the 1980s and has resulted in a relatively large number of abandoned houses and unmaintained community infrastructure.

New economic development following the decline in mining has remained limited in both villages. There are no commercial businesses in Aspliden, while Kristineberg has retained a locally based motor mechanic, but relies otherwise on a local community association for the provision of key services (including a small shop, petrol station and restaurant). The same local association runs a hostel with basic accommodation and seasonal guided tours to an "underground church" – a tourist attraction based on an interesting geological feature (interpreted as a vision of Jesus Christ) discovered in a disused mining cavern. Tourism is, however, mainly limited to day visitors during summer, with very few tourists staying overnight in Kristineberg. Working-age residents of both Aspliden and Kristineberg predominantly commute to the municipal centre of Malå for employment, even though Kristineberg is officially in the municipality of Lycksele, whose main town is 70 km away (compared with 25 km to Malå town).

Similar to Aspliden and Kristineberg, Adak and Adakgruvan emerged as a pair of pre-existing and purpose-built settlements around mining. Adak was established as a farming settlement around the turn of the 19th century, and by 1900 had grown to about 200 inhabitants. At the 1930 census, Adak was recorded as having 380 residents, with quite a diverse workforce including a number of retail service workers, tradespeople, nurses and teachers. There were also more people employed in forestry (about 35% of the workforce) than in farming (about 30%) by that time. Adakgruvan was built at the same time as Kristineberg, but as a planned "companion town" to Adak. While building Adakgruvan, the mining company also invested in new housing and social infrastructure in Adak, and both villages peaked in population in 1960, with around 600 residents in Adak and 350 in Adakgruvan. Unlike Kristineberg, Adakgruvan was never intended for permanent occupation, and by 1980, it was closed down and all physical infrastructure moved away. Excess housing was also moved out of Adak in the 1980s as result of declining mining workforces, meaning that the village does not have the same derelict infrastructure legacies as Kristineberg.

Adak's population has stabilised since the early 2000s at just under 200 residents, and despite losing many of its social, public and commercial services, the village has managed to retain some

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locally based businesses and its local store (currently run by a community association). There is a small manufacturing company (which has been in operation since the 1920s) and a motor mechanic run by new migrant entrepreneurs, but employment is otherwise mostly dependent on jobs in Malå. Some of the local heritage dating to the mining era has been converted into small tourism attractions, including a museum and a heritage movie theatre, which hosts an annual film festival. Yet, notable economic diversification in terms of tourism employment or businesses has been equally limited as in Kristineberg.

Kristineberg and Adak/Adakgruvan experienced environmental impacts from mining. The main lake at Kristineberg is only now beginning to recover from acidification and mass die-off of fish stocks that were primarily caused by mine waste (Holmström, Salmon, Carlsson, Petrov, & Öhlander, 2001). The lakes and streams around Adak were also affected by mining, but to a lesser extent, and environmental recovery was well progressed by the turn of the current century (Bhattacharya, Routh, Jacks, Bhattacharya, & Mörth, 2006). The impacts from mining on reindeer herding are not known, and there are generally few markers of the Sami heritage and its relation to mining in either of our three surviving villages, although these settlements are located in areas that were core reindeer herding sites prior to the mining boom (Berg, Valinger, Lind, Suominen, & Tuomasjukka, 2016).

Not much is reported in academic or popular literature about the Sami history of these villages, or the nature of contact between Sami, settlers and the mining industry. Traditionally, the Malå region was home to Forest Sami who typically used smaller areas of land for migration than Mountain Sami and were primarily residing in "Sami taxation areas", meaning they paid taxes to the Crown. Kristineberg and Aspliden were in the Kidnihaas Sami taxation area (Norstedt, 2011). Adak (*Adichen Oiwe*) was in the Sami taxation area of Ainajaur/Nuskulusoive (Norstedt, 2011) and later Vourbejaure (Marklund, 1999). Kidnihaas was one of the first Sami taxation lands in the Malå area to be colonised by settlers, affecting reindeer migration routes, as well as fishing, hunting and gathering activities. Vourbolandet, on the other hand, has a long history as a reindeer migration route, and a fishing, hunting and gathering area among both local Forest Sami and long-distance migrating Mountain Sami. According to oral tradition, the first settlement close to Kidnihaas was established in 1753 (Lundmark, 1943) and near Adak/Adichen Oiwe in the early 1800s (Marklund, 1999). In 1886, reindeer herding in Sweden was re-organised from family-based Sami taxation areas into today's Sami "villages" (reindeer herding cooperatives). The 1886 legislation discriminated against Forest Sami rights to reindeer herding, resulting in Forest Sami being assimilated into settler society more quickly than their mountain counterparts (Lantto & Mörkenstam, 2008; Marklund, 2015). Today, the Malå region has the last remaining Forest Sami village still active in the county of Västerbotten.

It is important to note that the demographic pathways of the four mining villages cannot be seen in isolation from the broader demographic and economic trends facing northern Sweden during the last century. In fact, the population development of the three surviving villages since the early 20th century resembles that of many villages in the inland north (Carson, Carson, Porter, *et al.*, 2016). Much of the region was settled relatively late in comparison to the rest of the country, and early settlements relied predominantly on small-scale subsistence farming and forestry activities. Populations typically remained low, and population growth limited until the 1920–1930s, with settlements rarely exceeding a few dozen or hundred residents. At that point, increased demand for natural resources, notably minerals and timber, as well as energy, led to an intensification and industrialisation of those activities and triggered the construction of associated infrastructure including roads, railways, basic processing facilities (e.g. smelters and mills) and hydropower plants. Large and rapid population growth accompanied this economic shift in the inland, with populations typically doubling or tripling in size in most towns and villages between 1920 and 1960.

The "boom" quickly entered a phase of decline starting in the 1960s, when many of the large infrastructure projects in the inland came to an end. This change was accompanied by a decline in manufacturing employment (as a result of increasing mechanisation), a growth in public sector employment, and an ongoing concentration of such employment and the population more broadly in urban centres (Hedlund, 2017). Population loss in the inland was further exacerbated by the abandonment of much of the agricultural activities of the north during the 1950s and 1960s as younger generations of farming families left to seek other employment opportunities. Almost all towns and villages outside of the municipal centres have lost population since the 1960s as a result. Population loss, and the growing importance of municipal capitals as centres for public services, has led to the closure of schools, shops and health stations in the smaller villages. Some villages, however, are experiencing something of a revival brought about in part by the arrival of small numbers of lifestyle migrants from Western European countries, in part by some resettlement of refugees and asylum seekers, and in part by a return to family land holdings by people approaching retirement age (Carson, Carson, Porter, *et al.*, 2016). Development of the tourism industry is also having an impact, although primarily in the mountain areas some distance to the west from the case sites in Malå (Lundmark, 2006). There is currently limited academic literature discussing what attributes might make villages in this part of Sweden susceptible to further population loss or attractive to new populations. Industrial legacy, be it in mining, forestry or energy sectors, is likely important in this regard.

The "boom and bust" and subsequent transition or revitalisation experiences of mining villages therefore need to be seen as part of, or illustrative of, the general patterns of growth and decline of Sweden's northern resource periphery, rather than an anomaly within the region. Yet, our study also emphasises how certain types of settlement and engagement with the resource sector – most notably the purpose-built company town models and temporary worker settlements that have been common in the case of mining – have reinforced particular local demographic experiences that are less pronounced in villages that have evolved without direct control of those companies.

Methods

Data were drawn from a variety of sources including Sweden's population census (1900, 1910, 1920 and 1930), and digitised resident lists (*befolkning*) accessed through https://www.arkivdigital.net/swedish-genealogy (1950, 1960, 1970, 1980 and 1990), which included information on age, sex, occupation and place of birth at local village level. Some data for Adak and Kristineberg for 2000 and 2010 were drawn from the Astrid database (containing annual register data from Statistics Sweden) located at Umeå University. A snapshot of the village populations for 2015 was obtained from Malå municipality (for Adak and Aspliden) and Lycksele municipality (for Kristineberg). Census data from 1900

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and 1910 were accessed through the North Atlantic Population Project (NAPP) database (nappdata.org). Data for 1920 and 1930 were manually compiled from the census summary sheets digitised by the Swedish Archives (riksarkivet.se).

These data sets were combined and used to identify the number of inhabitants, their age, sex and place of birth. Place of birth data did not include international locations in 1970, 1980 and 1990, but in 1990 at least an international place of birth could be imputed from the absence of a Swedish place of birth in the person's record. Occupation data were also available up to 1970 (1960 for Aspliden), although the classification system was quite different in 1970, making only very general comparisons possible. For 1990, 2000 and 2010, industry of employment rather than occupation data were available.

The research focuses primarily on the period 1900–1990, with the period prior to 1930 representing the pre-development phase of the resource cycle, the period 1930s–1940s representing the early period, 1950s–1960s the middle period, and 1970s–1990s the decline and (early) transition phases. Some commentary on later transition for Adak and Kristineberg can be made from the 2000–2015 data. Data were analysed to identify similarities and differences between the four villages across these phases in terms of:

- rates of population growth and decline;
- total sex ratios (number of males for every 100 females in the population) and sex ratios for young adults (aged 15–39 years);
- percentage of the population aged under 15 years, 15–39 years, 39–64 years and 65 years and over;
- percentage of the population born outside of the immediate region and the diversity of places of birth of the population. The "immediate region" is defined as the municipalities immediately adjacent to Malå (Norsjö, Arvidsjaur, Sorsele, Lycksele);
- changes in occupation and industry of employment (as available);
- in the absence of detailed migration data, analysis of the changing age and gender structure of the population also provide insights into what groups of people arrived and departed first during the periods of growth and decline;
- a population is considered to have greater "balance" if there is a nearly equal ratio of males to females, and if there are high proportions of children and young adults compared with older age groups. "Balance" in this respective is therefore a comparative rather than an absolute term.

A considerable limitation in the analysis is the lack of data from the 1940 census. Published data from that census provide a population count, gender distribution and very limited age distribution for Kristineberg, but not for the other villages. Unlike the 1920 and 1930 census records, the original summary sheets are not digitised, and no means of accessing data at the individual or village level was available.

There is also a considerable limitation when it comes to examining demographic change within the Sami population, and this requires more detailed discussion. In this context, it is important to emphasise that the research team included a researcher (Nilsson) who is of Forest Sami origin with ancestry from the study area. Her local knowledge of the area, along with her language skills (both in Swedish and the local Sami language of the Malå area – Umeå Sami) and her connections to members of the Malå Sami community, was critical in identifying, interpreting and validating the fragmented data sources that exist about the Sami in this area. This was an important complement to the knowledge of the remaining research team who had international experience in studying demographic change in sparsely populated resource peripheries but more limited understandings of local histories and language skills.

Identifying Sami people based on ethnicity is very controversial in Sweden and has been prohibited in official government data collections since the 1940s, meaning that there is very limited information about the size, composition and spatial distribution of the Sami. Definitions of who is (and who is not) a Sami have long been debated, not least among Sami individuals themselves, which is also reflected in debates about who can be a member of the Sami Parliament or of reindeer herding cooperatives. While information on reindeer herders has at times been used to make observations about Sami geography in northern Sweden (e.g. Leu, 2018), this approach is of limited use for the purpose of this study as it excludes a most likely substantial part of the region's Sami population who is not affiliated with reindeer herding. This is a particular issue for many Forest Sami who had lost their rights to reindeer herding earlier and were subsequently no longer considered as Sami in official records.

Historical census records (prior to 1940) contain some limited information about Sami ethnicity; however, the reliability of these indicators at village level is highly questionable due to inconsistencies in how Sami were identified in different parishes and across different census periods (Carson, Carson, Nordin, & Sköld, 2017). The only digitised individual data on ethnicity in Sweden are available through the NAPP database and covers the period 1880–1910. In the NAPP data dictionary, however, it is clearly stated that the variable containing codes for ethnicity is highly problematic as it has no direct correspondence in the Swedish census database. Data from the Sami registry of the Skellefteå genealogists' association (Lundström, 1990) were used in an attempt to validate the NAPP data, together with original census data from 1910 (riksarkivet.se) and personal local knowledge held by our researcher with local Forest Sami expertise. She was able to identify several critical anomalies within the NAPP data set. For example, the ancestor of a Sami person active today in Sami culture, art and reindeer herding was classified as non-Sami, while the descendant of a forestry officer (who wanted to access the ore deposit of Kidnihaas/Kristineberg in the late 1800s and consequently used his economic power to dispossess the residing settler) was classified as Sami, even though photocopies of the original Swedish census data from 1910 showed no signs of the forest officer being of Sami origin. There were also inconsistencies in terms of how children of Sami and non-Sami residents were counted, resulting in much higher and unrealistic child ratios for non-Sami. Considering these anomalies, the NAPP data set was considered inappropriate for generating a realistic historic picture of the local Sami population, similar to what has been found by Carson *et al.* (2017) in recent research about the Sami's demographic situation in Jokkmokk further north. Similarly, later census data records from the 1920 and 1930 censuses contained no or very irregular ethnic identifiers across different villages and parishes, making any reliable claims about the size and composition of the Sami population highly problematic, and comparisons between our villages impossible. Instead, our researcher with local Sami expertise consulted several alternative data sources to find indicators about the changing Sami geography in the region. These included an essay by Malå School teacher Georg Uggelberg in 1965 (Uggelberg, 1965) with data on the size of the Malå Sami population 1860–1950, as well as an interview with the chair of the Malå Sami Association (personal communication, 19 January 2018). An attempt to merge these estimates

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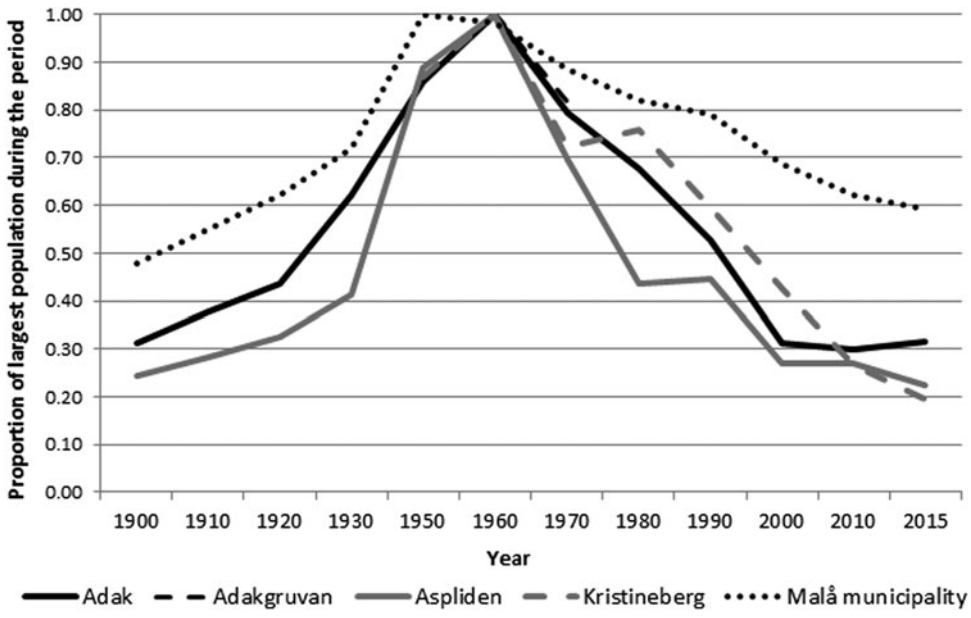

Fig. 3. Residential population relative to peak population, 1900–2015.

into numeric data was, however, criticised at a public seminar in Malå (held on 16 August 2019) by members of the local Sami community who raised concerns that the estimated figures were poorly substantiated and, thus, could damage Sami society if used for the wrong purpose. Due to this critique, the authors decided not to present these data.

Results

Population development

Figure 3 shows the residential population of each of the villages, and the Malå municipality, relative to their peak population during the period 1900–2015. Peak population for the municipality was about 5300 residents in 1950. Each of the villages peaked shortly afterwards, with Adak having 600 residents in 1960, Adakgruvan 350 residents, Aspliden nearly 200 residents and Kristineberg nearly 1000 residents. The pre-existing villages Aspliden and Adak were already experiencing population growth prior to mining development (the period 1900 to 1930), with particularly strong growth in Adak between 1920 and 1930 (from 44% of peak to 60% of peak). The early period of mining coincided with the growth to peak, with the population of Adak nearly doubling and the population of Aspliden more than doubling between 1930 and 1960. The purpose-built settlements Kristineberg and Adakgruvan had very similar rates of growth and decline from their inception in 1940 to the closing of Adakgruvan by 1980. Overall, each village had a similar population loss starting towards the end of the middle period and extending across the decline and transition periods (1960–1980), and the loss was more substantial than that experienced by the municipality as a whole. However, experiences of decline and transition since the 1970s have been different for each of the three surviving villages. Kristineberg had a period of population stability in the 1970s, coinciding with the commencement of the most recent mining project, but Aspliden and Adak both declined substantially during this time. Aspliden had population stability between 1980 and 1990 and has had minimal population loss since 2000. Adak has had a stable population since 2000, with even small population growth in recent years.

Gender balance

Adak had a high sex ratio throughout the whole resource cycle, although it declined from 126 males for every 100 females at the end of the early phase to 104 males for every 100 females by 1990, before increasing again in more recent times (see Table 1). Adakgruvan had similarly high sex ratios during its period of existence, although the ratio in 1960 was lower than that in Adak. Aspliden had fewer males than females at the turn of the 20th century, but more males than females by the end of the pre-development phase. Sex ratios remained over 100 throughout the early, middle and decline phases. The ratio did decrease between 1980 and 1990, and there were fewer males than females in the population in 2015. Kristineberg has had very high sex ratios for the entire cycle.

For much of the pre-development phase, both Adak and Aspliden had very high young adult sex ratios, although there was a dip in 1920. Young adult sex ratios were low in 1950 and 1960 but were very high (particularly in Aspliden) thereafter. Kristineberg also had lower young adult sex ratios in 1950 and 1960 than at other points, while there were more young adult women than men in Adakgruvan in 1950 and 1960. The data suggest a substantial feminisation of the young adult population in Adak and Kristineberg between 2010 and 2015.

Age distribution

During its brief existence, Adakgruvan experienced substantial population ageing. The proportion of the population aged under 15 years and between 15 and 39 years in 1950 (33% and 42%, respectively) decreased by 1970 to 24% and 32%, respectively, while the proportion aged 40–64 years and 65 years and above increased from 22% and 4% to 33% and 13%. Adakgruvan had the highest proportion of population in the 65 years and over

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Table 1. Total population and young adult (aged 15–39 years) sex ratios, 1900–2015

	Number of males per 100 females				Number of males aged 15–39 per 100 females			
Year	Ad	Ag	As	Kr	Ad	Ag	As	Kr
1900	122		95		138		83	
1910	109		96		127		114	
1920	126		110		100		100	
1930	122		117		138		131	
1950	111	114	104	122	99	98	98	113
1960	126	113	102	110	116	91	103	113
1970	119	117	108	125	115	111	200	136
1980	110		113	108	133		200	113
1990	104		105	114	118		131	136
2000	115			108	100			135
2010	111			122	120			118
2015	108		96	122	90		67	87

Ad, Adak; Ag, Adakgruvan; As, Aspliden; Kr, Kristineberg.

category of all four villages in 1970, although Aspliden also had close to 13%. Kristineberg, however, had just 2% in this age group in 1970 and only experienced substantial ageing from 1980 onwards (see Fig. 4a). Generally, there were similar patterns of ageing in Adak and Aspliden from 1900 to 1990, although Aspliden had higher proportions of people aged under 15 years for much of the pre-development phase and aged more rapidly between 1970 and 1980 (see Fig. 4b and 4c). There was a very unusual age profile in Adak, Aspliden and Kristineberg in 1950, with very few people aged under 15 years (just 10% in the latter two and 17% in Adak). There is a possibility that this reflects inaccuracies in the data; however, the profile for Adakgruvan was not unusual (33% in this age group compared with 32% in 1960). Nevertheless, the apparently dramatic change in the younger two age groups between 1950 and 1960 must be interpreted with caution. Combining the two younger age groups shows a decline in Aspliden (from 73% to 65%) that was not experienced in Adak until 1960–1970 (from 68% to 55%) or Kristineberg until 1970–1980 (from 70% to 61%).

The contemporary age profiles of Adak and Kristineberg are substantively similar, with around 10% aged under 15 years, between 15% and 20% aged 15–39 years and 30% aged 65 years and older. The three villages experienced substantial ageing between 1970 and 1980, and Kristineberg experienced another "jump" in people aged 65 years and over between 2010 and 2015. In 2015, Aspliden had a higher proportion of people aged under 15 years (17%) and a lower proportion aged 65 years and older (22%). The most dramatic change since 1990 in Aspliden was growth in the proportion of the population aged 40–64 years (from 29% to 41%).

Population born outside the region

Table 2 shows the percentage of the population who were born in the home or neighbouring municipalities of each village. In the pre-development phase, almost all residents of the pre-existing villages Adak and Aspliden had been born in the immediate region. The purpose-built settlements Adakgruvan and Kristineberg began with large proportions of people born outside of the region, and there was a dramatic decrease in local-born population in Aspliden between 1930 and 1950, but less so for Adak, which instead experienced a decrease between 1950 and 1960. Aspliden returned to a predominantly local-born population by 1960. Adakgruvan was populated substantially by local-born people by 1960, while Kristineberg continued to have a relatively high non-local-born population throughout.

All four villages had about 85% of their "non-local" population born in the four northern counties of Sweden (Norrland) in 1950. However, there were far fewer Adak residents (35% of non-local-born) than residents of the other villages (each with 53%) born in Boliden's home town of Skellefteå. There were just a handful of residents of any of the villages born outside of Sweden, and all of these were from Finland or Norway. Birthplaces in southern Sweden were widely distributed, with only Kopparbergs Län (now Dalarna County, an area with a long history in copper mining) emerging as a substantial "source" of residents (18 in Kristineberg). The situation was quite similar in 1960, although by this time there was a handful of residents of Kristineberg who had been born in Germany and Hungary, and ten Norwegian born residents of Adakgruvan. While overseas-born data were not available for 1970, there was a decrease in the percentage of "non-locals" born in Norrland for Aspliden and Adak (to 75%), and an increase for Adakgruvan (to 95%). By 1990, the percentage of non-locals born in Norrland (around 55% for Aspliden and Adak, and 69% for Kristineberg) and Skellefteå (14% for Adak, 16% for Kristineberg and 30% for Aspliden) had declined substantially, and there had been a large increase in the number of residents born outside of Sweden (to between 10 and 20% of the non-local population), likely because of the temporary settlement of refugees and immigrants. Interestingly, other larger "mining boom" locations in the north (Kiruna and Gällivare in particular) were not highly represented in places of birth throughout the period, nor was the county capital, Umeå. The decreases in local-born populations in Adak and Kristineberg for 2000 and 2010 are largely explained by a higher percentage of people born in Norrland but not in immediately neighbouring municipalities.

Occupational profile

Almost all working residents of the pre-existing villages Adak and Aspliden in 1900 were tenant farmers or domestic servants. This was still largely the case in Aspliden in 1930, but forestry had overtaken farming as the most important occupation in Adak. Direct occupation as "mine worker" accounted for 37% of employment in Kristineberg in 1950, and 47% of employment in Adakgruvan (see Table 3). A further 32% and 22%, respectively, had trades occupations likely to be related to mining. Forestry and farming (collectively 20%) was more important in Adak than in Kristineberg (9%). Mining and associated trades had made a substantial impact in Adak and Aspliden, but farming and forestry retained a high share of the workforce. The services sector was far more prominent in Adak and Kristineberg than in the other two villages. By 1960, mining had become less prominent in Adakgruvan, while services had become more prominent. Concentration of employment in mining and associated trades appears to have occurred between 1960 and 1970 (acknowledging the differences in classification of occupations in the respective data sets). Certainly, forestry and farming employment decreased, along with services employment in Adakgruvan.

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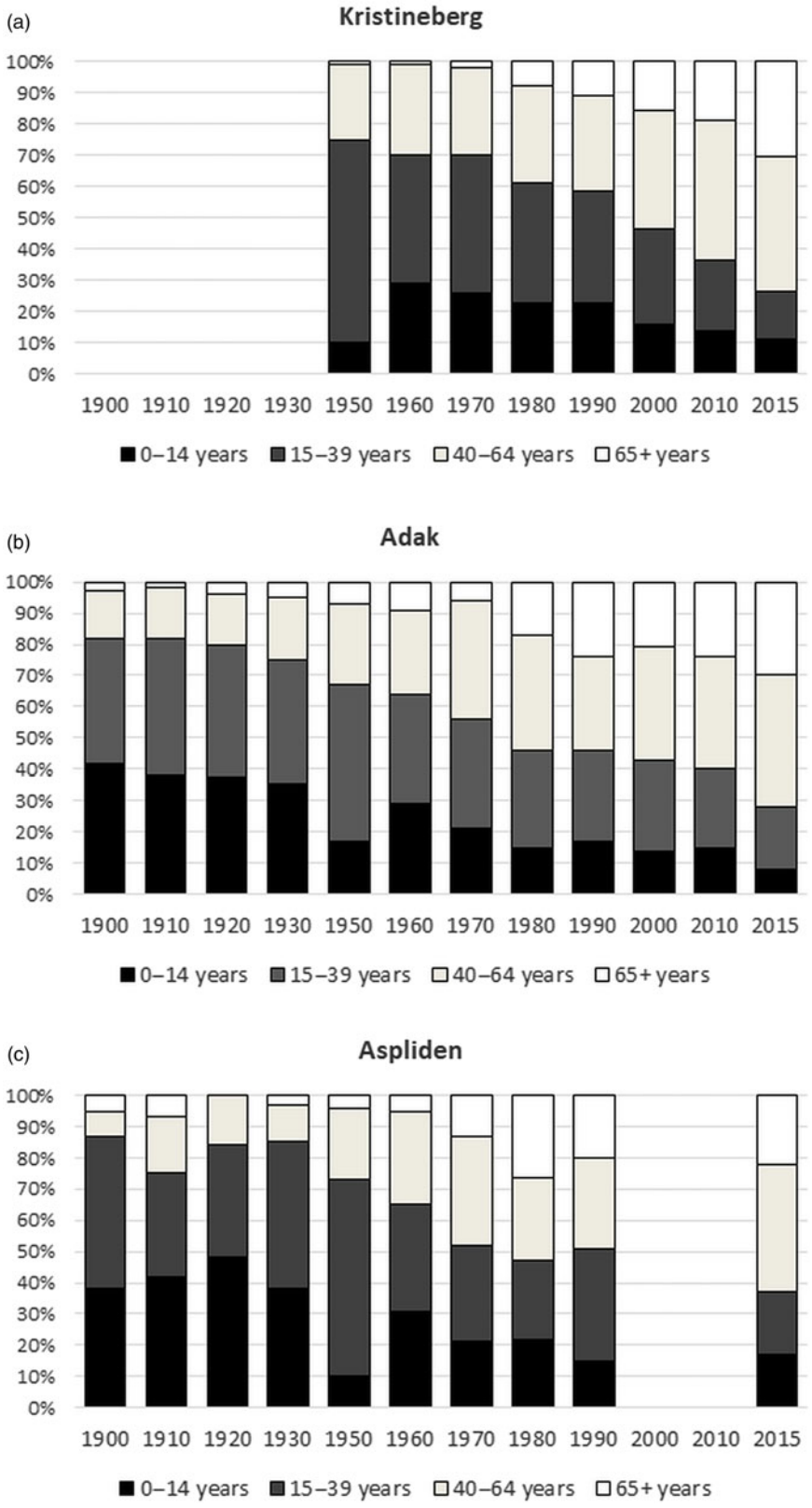

Fig. 4. Age distribution in Kristineberg (a), Adak (b) and Aspliden (c) 1900–2015.

In 1990, still nearly half of the Kristineberg workforce and 40% of the Adak workforce were employed in the mining industry. This reduced to 26% of the workforce in Kristineberg and 5% of the workforce in Adak by the year 2000. Mining industry employment was slightly higher in Kristineberg (31%) and Adak (8%) in 2010 compared with 2000. Employment in forestry and farming was less than 5% of the workforce in both villages during the 1990–2010 period.

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Table 2. Percentage of village population born in the immediate region, 1900–2010

Year	Adak	Adakgruvan	Aspliden	Kristineberg
1900	99		100	
1910	99		100	
1920	97		100	
1930	97		97	
1950	85	52	62	32
1960	63	86	79	44
1970	59	85	84	52
1980	84		86	60
1990	79		77	73
2000	74			66
2010	76			67

Table 3. Summary of occupations (as percentage of the workforce), 1950–1970

	Aspliden	Kristineberg	Adak	Adakgruvan
1950				
Mining	30%	37%	23%	47%
Associated trades	10%	32%	14%	22%
Services	9%	16%	14%	7%
Forestry/farming	37%	9%	45%	20%
1960				
Mining	29%	40%	21%	34%
Associated trades	21%	24%	16%	18%
Services	11%	18%	13%	23%
Forestry/farming	30%	11%	41%	20%
1970				
Mining	n.a	80%	63%	85%
Associated trades				
Services	n.a	14%	15%	9%
Forestry/farming	n.a	0%	5%	0%

Sami geography

Estimates of the number of Sami people in the Malå region around the turn of the 20th century vary widely depending on the source and the criteria used to identify Sami ethnicity. According to Sami identifiers available through the NAPP database, our interpretation is that up to two-thirds of the population of Aspliden and four-fifths of the population of Adak may have some kind of connection to Sami culture. In contrast, comparing the 1900 NAPP data to the Sami registry of the Skellefteå genealogists' association (Skellefteå släktforskarförening) created by Kjell-Åke Lundström in 1990 reveals no Sami at all in the Aspliden area, and fewer than 5% of a Sami population in the Adak area. Today, Malå is a Sami administrative municipality, with a reference group advising local government. In the contemporary Sami cooperative, there are an estimated 100 reindeer herders, of which 12 are active. Malå's Sami association is the largest local association with more than 300 members, all of them Sami and most of them residing in the area. Adak remains an area of key and core use for reindeer herding according to a recent survey (Berg *et al.*, 2016), although large areas around Aspliden and Kristineberg are no longer commonly used, as a result of mining activity and more recently also the installation of wind power plants. Outside the frames of the Sami association, a private Sami company is keeping reindeer within fences for tourism purposes in Släppträsk close to Kristineberg, emphasising that diversified Sami livelihoods exist in the area.

Our attempts to identify population change among the Sami along the periods of the resource cycle clearly failed due to the encountered data limitations and the methodological and ethical issues discussed in the methods section. This is problematic insofar as anecdotal evidence, including media reports and government documents, as well as personal knowledge of the area, suggest that Sami people raised concerns about the impacts of mining on their livelihoods at various times during the 20th century. Both reindeer herding and non-reindeer herding Sami from the region have continued to be active in political life in the region, including protesting the proposal for a nuclear waste facility in the mid-1990s, and lobbying for the repatriation of significant cultural items removed during mining. How such perceived impacts and tensions have been accompanied by (or even contributed to) demographic transitions, remains unclear and points towards an important gap in the literature on the relationships between Sami societies and mining in sparsely populated areas.

Discussion

Each of the four villages experienced very similar rates of gross population growth and decline during the early, middle and decline periods of the resource cycle (1930–1970). Kristineberg perhaps best matched the profile expected of a new purpose-built mining settlement with a population dominated by young adult males and few children or older people. Adakgruvan, however, while still having an overall male imbalance, had a female bias among young adults, and a proportion of children similar to that of the pre-existing village of Adak, indicating an attractiveness to young families. Adak's and Aspliden's populations both became somewhat more balanced, at least from a gender perspective, as they grew rapidly between 1930 and 1950. The data suggest, however, that growth in these two villages was created by young adults (males and females) but without children. Growth in the four villages was also on the basis of a diversification of the geographical origins of the population, although with the new sources largely confined to the "home base" of the mining company (Skellefteå) and an enlarged "neighbourhood" of northern municipalities. It was not until well into the transition phase (1980 and 1990) that birth locations outside of the north became important contributors to Adak and Aspliden, and the mining boom attracted few international-origin residents.

The growth of Adak and Aspliden in the period immediately prior to mining (1920–1930) had similar gender characteristics to that in the early period of operation. Both villages increased the proportion of women, and particularly young adult women, in the population. However, pre-development growth was driven entirely by people born in the immediate region. Pre-development growth can be linked quite strongly to growth in the forestry sector's local operations (especially for Adak).

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Population decline between 1960 and 1970 was accompanied by an increase in the male bias among young adults in Adak, Aspliden and Kristineberg, but a decrease in Adakgruvan. Adakgruvan did have an increased male bias in the total population, which reflected quite substantial ageing and the departure of older women from the population. Ageing effects were less dramatic in the other three villages at this time, but there was a notable decrease in the proportion of children in the population. There were also fewer non-local-born people in all villages in 1970 compared with 1960, indicating that those who had been latest to arrive were first to leave.

Overall population development in Adak does not immediately indicate a demographic dividend from the closing of Adakgruvan between 1970 and 1980. However, Adakgruvan by 1970 had a relatively large cohort of older, local-born males, and there is some evidence in Adak's pattern of population ageing and increasing local-born population between 1970 and 1980 that there was some resettlement from the former to the latter village.

Despite having different levels of (planned) integration with mining, different local service profiles and different population sizes, the pre-existing villages Adak and Aspliden had very similar demographic experiences right into the transition phase. The occupation data reveal high levels of mining employment in Aspliden, despite a lack of direct mining company investment in the village. It is likely, therefore, that both the shared history of farming and forestry development and engagement with mining determined the similar development paths of Adak and Aspliden. Similarities extend to the present time, when the populations of both villages in this century have at least temporarily stabilised at about the same level as at the turn of the previous century.

During the early and middle phases of the resource cycle, Kristineberg was not substantially less balanced than Adak or Aspliden in terms of gender or age, suggesting that being a planned and purpose-built company town did not result in markedly different age–sex balances compared with pre-existing villages. Kristineberg did, however, have fewer local-born residents, and it may be this aspect of its demographic make-up that has contributed to its continuing decline in this century. It is worth noting also that Kristineberg disengaged from the reindeer husbandry sector quite early in the time period being examined here, and this may have also contributed to a relative lack of local attachment when compared with Adak.

Mining continued to be an important industry of employment particularly in Kristineberg through the early 2000s, while forestry and mining both played only a small direct role in Adak. Both villages have experienced a dramatic change in the profile of their younger populations in just the few years since 2010. The young adult population (aged 15–39 years) has declined dramatically (in absolute and proportional terms) and has changed from male dominated to female dominated. This potentially presents very different possibilities for new economic activities than what might have existed even a decade ago.

Conclusions

The villages in this research, even at peak population, were substantially smaller than those that have featured in other research into the local demographic impacts of mining. As a result, they are likely to have more volatile demographic profiles, with the actions of just a few people sufficient to dramatically impact population balance. Nevertheless, there were persistent indicators of imbalance that aligned in some ways with what the literature has proposed, including a strong overall male bias during the early and middle phases, and rapid ageing and loss of young workers and children in the decline and transition phases. However, there was a key role played by women, and particularly young adult women, in the population growth that coincided with the early mining phase in Adak, Adakgruvan, and Aspliden, but not in Kristineberg. This aspect of imbalance may have contributed to Kristineberg's relatively poor contemporary position, despite that village having seemingly better population prospects by 1990.

Male bias was evident in Aspliden and Adak prior to mining development and can be linked with development of the forestry industry. There is no substantial evidence that mining exacerbated this bias in either village, particularly considering that mining employment essentially replaced forestry employment in Adak by 1970 without a dramatic impact on sex ratios. As previously noted (Carson, Carson, Nordin, *et al.* 2016), alternative economic activities at this time, such as energy development, forestry and even farming, were associated with preference for male workers and male dominated populations. Consequently, there does not seem to have been much value in avoiding mining (assuming that one could avoid mining, as the case of Aspliden shows) if the ambition was to develop a more gender balanced population. Gender imbalance has persisted even as mining declined.

Mining certainly contributed to the diversity of places of birth of the populations of the villages, and the increasing population mobility that resulted may have contributed to the rapidity of population decline and the failure to find alternative ways of retaining population. This is particularly the case for Kristineberg, whose "incomer" population was very highly spatially linked to the mining sector. However, Aspliden's relatively high share of local-born population even during peak mining does not seem to have made a difference to the experience of decline, although that difference may only be felt in contemporary times as Adak and Aspliden, both with larger local-born populations than Kristineberg in 1980 and (marginally) in 1990, have found some population stability in the past decade.

As mining workforces become more centralised and less locally based (Storey, 2016), it is tempting to think that local communities can avoid the negative consequences of demographic booms and busts, while still somehow managing to take advantage of the opportunities offered by mining as a lever for economic development. The research here suggests, however, that even very different approaches to managing mining's human geography – ranging from integrating to separating pre-existing villages from mining projects, or building new company towns as temporary or permanent settlements for mining – are likely to have similar effects. What might be important is sustaining local activities that provide some sort of baseline attachment to place for local-born (and certain incomer) populations. Kristineberg, with essentially no pre-mining settlement history, and an almost single-minded focus on servicing mining even as the decline was evident, may have had less opportunity for formal or informal constructive planning.

While it is historically interesting to see how four different villages in close proximity to new mining developments changed demographically over the course of a mining cycle, it is unlikely that the same resource cycles and village trajectories will be repeated in the future. The construction of new villages to service mining (or any other single industry) has become extremely rare. Rather, the resource settlement cycle means new mines are now to be operated by workers living in the municipal capitals (a process which has affected Kristineberg since the latest mining projects opened in the late 1970s) or commuting from much further afield

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(Storey, 2016). Were there to be another mining boom, it would sit on top of an economy now dominated by service sectors (primarily public services, but also tourism in some areas, along with lifestyle and retirement-related development) which have different age and gender workforce compositions (Hedlund, 2017), and are mostly less susceptible to their own boom and bust cycles than the agricultural and forestry sectors which pre-dated mining in these case study sites. The probability is, therefore, that new mining would be both economically and demographically divorced from even very proximate settlements. The experience of Aspliden, however, should not be overlooked, and it is still probable that mining would interact with local settlements (at least for short periods during the construction phase), despite the forces promoting separation.

The potential role that environmental, social, cultural and infrastructural impacts can play in determining the demographic response to a resource cycle should also not be overlooked. While not an explicit focus of this paper, it is worth noting that negative environmental impacts have been greater at Kristineberg than at Adak, and a lack of local engagement in mining governance may have contributed to that. Also, the infrastructural legacies apparent in a planned company town (e.g. homogenous housing styles, as well as large and abandoned workers' buildings that are difficult to repurpose after the mining boom), and the resultant social stigma as an increasingly empty and abandoned "ghost town", are likely to have different demographic impacts (Carson & Carson, 2014). Settlements like Kristineberg appear to be less attractive to new migrant populations (e.g. retirees, lifestyle migrants and young families) in the transition stages than settlements like Adak where the mining bust has been less visually apparent.

In essence, while close integration with mining is becoming more difficult because of the capacities of small villages to absorb new populations and the mining settlement cycle, separation is likely to be an idealistic ambition and may come with its own barriers to effective constructive planning. As mining projects and workforces are becoming ever more mobile and temporary, and the establishment of new mining settlements is becoming less common (Storey, 2016), there is a need for continuing research to understand the demographic impacts of mining on local populations and settlements. In particular, there is a need for more comparative longitudinal studies that examine demographic change at a more nuanced geographical level and pay attention to a range of socio-economic indicators (including gender, age, occupational, mobility and Indigenous indicators) and can help us better understand the long-term impacts of mining beyond the immediate period of boom and bust.

Understanding the demographic consequences of mining projects for local Indigenous people remains a particularly important gap in the literature and requires more attention in future research endeavours. Although all the studied villages are situated in Sápmi, the traditional Sami lands of northern Norway, Sweden, Finland and the Kola Peninsula of Russia, our ambition to analyse demographic changes in relation to Sami populations in the area did not succeed. Such analyses are likely not impossible to perform with regards to early data (prior to 1940) but needs great effort in relation to data handling and interpretation, and careful methodological and ethical considerations (including verification across different data sets). This has, unfortunately, been far outside the scope and resources for this paper. According to our experiences from this study, using Sami ethnicity variables defined by others, such as those offered by the NAPP database, is not to be recommended due to the limitations explained above.

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